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### The development of theory-of-mind and the theory-of-mind storybooks

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# APPENDICES



- A) Example tasks of the ToM Storybooks
- B) Order of the tasks in the ToM Storybooks
- C) Overview of the justification categories

## APPENDIX A: Example tasks of the ToM Storybooks

Before beginning the test, the child is presented with drawings of five facial expressions (happy, scared, angry, sad, and surprised); there was also a neutral (just OK) face. The child was asked to provide labels with the faces in order to be sure that he/she recognized each emotional expression (see also Hadwin, Baron-Cohen, Howlin & Hill, 1996). If the child did not know or made a mistake, the experimenter gave the appropriate label. After practicing the emotions, the actual test begins.

There are 34 tasks (also see Appendix B); they can be divided in five groups.

### 1. Emotion recognition (maximum of 14 points)

There are five emotion recognition tasks: happy, scared, angry, sad and surprised. The child is presented with five situational descriptions. It has to choose the appropriate face and provide the correct emotion label. To avoid a response bias, the presentation order of the faces varied.

Example task (see Figure 1): *'Sam has won shooting marbles. He has won the most beautiful marble.'* Questions: 1) *Choose the face that matches. (emotion recognition)*, 2) *How does he look? (emotion naming)*, 3) *How come Sam is feeling happy?*

Figure 1. Emotion recognition task



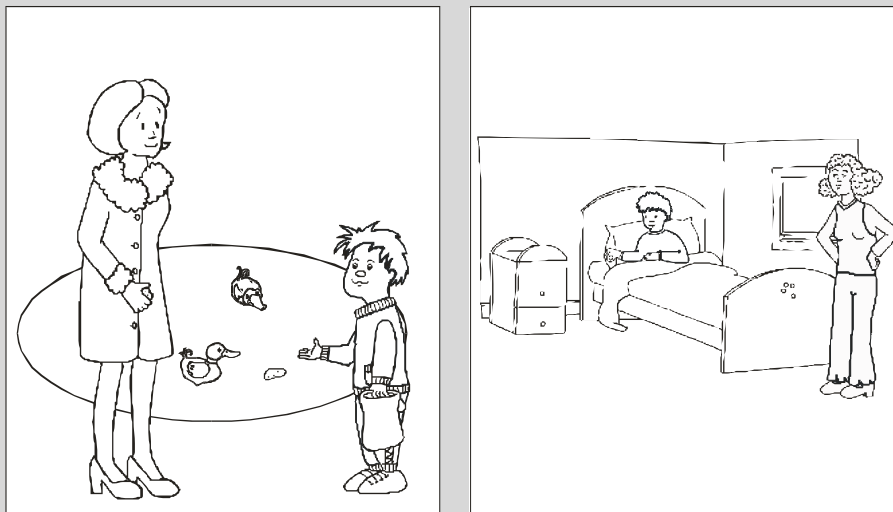
## 2. The difference between physical and mental entities

### *Mental-physical distinction (maximum of 24 points)*

Pairs of real-mental contrasts are used in which the child has to compare two characters that have corresponding objective and subjective experiences. The child has to compare real situations with pretending, dreaming, thinking about things, and remembering things. The (justification) questions and item sequence were counterbalanced.

Example task (see Figure 2): ‘*Sam, mummy and Sparky are going to the park. First, they are going to the pond. Sam gives bread to the ducks. And then mummy too. Sam’s friend, John, can’t go to the park today. John is sick and is lying in bed at home. John pretends to give bread to the ducks.*’ Questions: 1) *Who can really see the bread with his eyes? John or Sam?* (mental physical senses), 2) *How come... [Sam/John] can really see the bread with his eyes?* 3) *Who can really give the bread to the ducks now? John or Sam?* 4) *John plays. He pretends to feed the ducks. Can the mummy of John really give that bread to the ducks too?* (mental physical others), 5) *Who cannot save the bread now and give it to the ducks tomorrow? John or Sam?* (mental physical future).

Figure 2. Mental-physical distinction task



***Real-imaginary distinction (maximum of 8 points)***

Questions are asked about real items and imaginary, non-existing items.

Example task: ‘John and Sam are eating their sandwiches. ‘John’, says Sam, ‘Listen. I know a fun game. I am going to ask you strange questions.’ Questions: 1) Do yellow bananas exist? 2) Do dancing bananas exist? 3) Can you think of yellow bananas? 4) Can you think of dancing bananas?’

***Close impostors (maximum of 12 points)***

Close impostors are physical objects that do not possess all characteristics of real objects. Real physical objects, like for instance chairs, have three characteristics, namely behavioral-sensory evidence, public existence and consistent existence. Close impostors can only be perceived in one modality and cannot be touched or acted upon. There are two tasks: one task is on smoke, the other is on a nasty smell.

Example task (see Figure 3): ‘Sparky, the dog, is rolling in the mud. ‘Yak Sparky, you smell bad’, says Sam. ‘It stinks!’ Questions: Can Sam touch the smell with his hands? Can Sam smell the smell? (close impostor senses) Can mummy smell it too? (close impostor others) How come mummy can smell it ... [too/not]? Can Sam save the smell in a box and smell it again tomorrow?(close impostor future)

Figure 3. Close impostor task

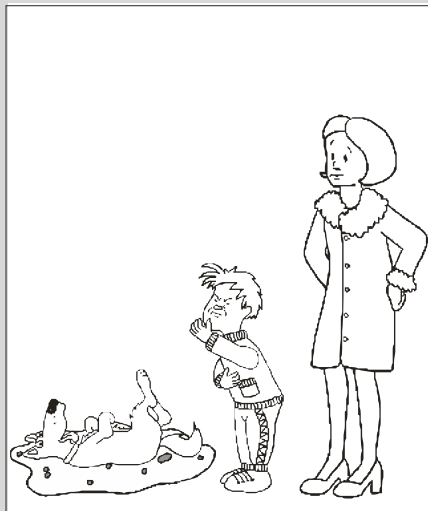
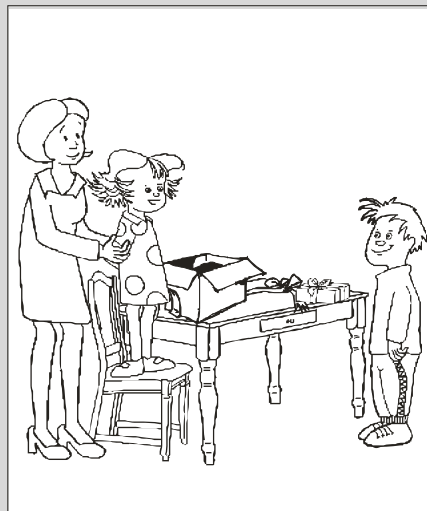


Figure 4. Seeing leads to knowing task



### 3. Perception knowledge (maximum of 3 points)

Only one task is involved. Questions are asked about the connection of seeing or not seeing something and knowing or consequently not knowing something (a subtest that was also included in the batteries of Tager-Flusberg, 2003).

Example task (see Figure 4): *'Today, it is Sam's birthday. He is five. In the room there are two gifts on the table: a little parcel and a big box. Lisa, his sister, is allowed to look in the box, Sam however, can only touch the box'.* Questions: 1) *Who knows what is in the box? Sam or Lisa?* 2) *Why does ... [Lisa/Sam] know what is in the box?*

### 4. Desires (maximum of 17 points)

The knowledge of desires allows one to predict both emotions and actions. Both sorts of tasks are incorporated into test items where desires are either fulfilled or not fulfilled.

There are five tasks on desire-emotions (wanting and getting/ not getting/ getting something else, and not wanting and not getting/ getting).

Example task: *'Come along Sam and Sparky', says mother, 'we are going home.' On the way home, Sam sees the ice cream man. He wants an ice cream. 'Mother, can I have an ice cream?', he asks. 'Off course', says mother and Sam gets a great ice cream.'* Questions: 1) *Choose the face that matches. (desire emotion recognition), 2) How does he look?(desire emotion naming), 3) How come Sam is feeling... [emotion]?*

There are three desire-action tasks. Example task: *'They are at John's house. But John has hidden himself. Sam wants to go swimming and John has to come along to the swimming pool. He goes to look for Sam in the cellar. He opens the door. And yes! There is John.'* Questions: 1) *What will Sam do now?* 2) *Why is he going ...[repeat previous answer]?*

### 5. Beliefs (maximum of 34 points)

Questions are asked about fulfilled or not fulfilled beliefs. These tasks, like desire tasks, can be used to predict both emotions and actions.

There are two belief-emotion tasks. Example task: *'Sam thinks his swimming trunks are on the chair. Sam goes to look on the chair. But there he finds a chicken!'* Question: 1) *Choose the face that matches. (standard belief emotion recognition), 2) How does he look? (standard belief emotion naming), 3) How come Sam is feeling... [emotion]?*

There are eight belief-action tasks. They are all first order belief tasks: on standard belief, changed belief, inferred belief, inferred belief control, not belief, not own belief (or diverse-belief), explicit FB and FB (change-of-location, see figure below) tasks.

Example task (see Figure 5): ‘Grandpa and grandma are paying Sam a visit. Sam gets rollerblades from grandpa and grandma. He’s very happy with the present. Sam puts the rollerblades in the toy trunk. Then, he goes upstairs. When Sam has left, his sister Lisa goes to the toy trunk. She likes to tease her brother. Lisa hides the rollerblades in the box! And then, she goes outside. Then, Sam comes back. He wants to rollerblade.’  
Questions: 1) Where will Sam look for his rollerblades? 2) Why is Sam looking ... [there]? 3) Where does Sam think his rollerblades are? 4) Where are they really?

Figure 5. False belief task



## APPENDIX B: Order of the tasks in the ToM Storybooks

Book	Task		Type	Quest. <sup>1</sup>	Max <sup>2</sup>	Scoring of justification <sup>3</sup>	
	Nº	Name				1 point	2 points
How is Sam feeling?	1	Emotion recognition	Happy	2 (1)	4	RM, GK & S	D, FB & VB
	2	Emotion recognition	Angry	2 (1)	4	RM, GK & S	D, FB & VB
	3	Emotion recognition	Scared	2	2		
	4	Emotion recognition	Sad	2	2		
	5	Emotion recognition	Surprised	2	2		
Sam goes to the park	6	Standard belief	Action	1 (1)	3	VRB	FB
	7	Standard belief	Emotion	2	2		
	8	Real-mental distinction	Pretend	4 (1)	6	LP	RR
	9	Desire	Action	1	1		
	10	Close impostor	Smell	4 (1)	6	IPP-almost	IPP & LP
	11	Desire	Emotion	2 (1)	4	VB, LP & S	D & RM
Sam goes swimming	12	Standard belief	Action	1	1		
	13	Standard belief	Emotion	2 (1)	4	LP, PC & S	FB & VB
	14	Desire	Action	1 (1)	3	RM & S	D
	15	Real-mental distinction	Dream	4 (1)	6	LP	RR
	16	Desire	Emotion	2	2		
	17	Real imaginary distinction	Think	4	4		
Sam visits his grand parents	18	Desire	Action	1	1		
	19	Explicit false belief	Action	2 (1)	4	VRB	FB
	20	Close impostor	Smoke	4 (1)	6	IPP-almost	IPP
	21	Not own belief	Action	1 (1)	3	VRB	FB
	22	Desire	Emotion	2	2		
	23	Real-mental distinction	Think	4 (1)	6	S	RR & LP
Sam at the farm	24	Standard belief	Action	1	1		
	25	Changed belief	Action	1 (1)	3	S	FB
	26	Real-mental distinction	Remember	4 (1)	6	LP	RR
	27	Not belief	Action	2 (1)	4	VRB	FB
	28	Desire	Emotion	2	2		
	29	Real imaginary distinction	Dream	4	4		
Sam's birthday	30	Perception knowledge	Know	1 (1)	3	LP	PC
	31	Desire	Emotion	2	2		
	32	Inferred belief control	Action	3	0		
	33	False belief	Action	3 (1)	5	LP & S	FB
	34	Inferred belief	Action	2	2		

*Note.* <sup>1</sup> number of test questions, and between brackets the number of additional justification questions; <sup>2</sup> maximum attainable points; <sup>3</sup> correct justification answers per task: D=desire, FB=fact belief, GK=general knowledge, IPP=insight physical process, LP=location possession, PC=perception criterion, RM=rest category mental state, RR=referring to reality, S=situational, VB=value belief, VRB=verb referring to a belief.



## APPENDIX C: Overview of the justification categories

In order to evaluate the justifications of children, we formulated 21 categories.

**Desire:** The answer refers to the protagonist's desire with respect to the situation. It involves wanting or desiring something. Ex. Why is Sam happy? *Because he wanted that ice cream.*

**Fact belief:** The child refers to the protagonist's knowledge. It involves thinking, knowing, being sure of, expecting or recognizing. Ex. Why does Sam look for grandpa there? *Because he thinks that is where grandpa is sitting.*

**Value belief:** The answer passes a value judgement on how the protagonist handles a situation. It involves verbs such as loves, dares, liking something, or finding it sad.

**Changed fact belief:** The answer refers to a revised belief on the part of the protagonist. This category is only used for the changed fact belief task. Ex. Why does Sam look for the chickens in the coop? *Because he now thinks the chickens are in the coop (At first, he thought they were in the field).*

**Insight physical processes:** The child gives an explanation of the working of a physical process. This category is only used for the close impostor task. Ex. How come Sam can't save smoke in a box and look at it again tomorrow? *Because smoke evaporates.*

**Reality status:** The child explains the reality of a subject or object. Ex. How come Sam can see the ducks? *Because he is really feeding the ducks. His friend is only pretending.*

**Perception criterion:** The child refers to a reality criterion: the use of senses (hearing, seeing, smelling) by the protagonist. Ex. How come Sam can see the bread with his own eyes? *Because he is looking at it.*

**Verb referring to belief:** Answers in which the verb say or tell is used instead of think. It is understood that saying is like thinking aloud and thus indicates belief. Ex. Why did Sam went looking there? *Because he said he would (Note: In the text it is explicitly mentioned that Sam thinks they are there.).*

**Location possession explanation:** The child very clearly refers to the location or someone's possession of an object (as specified in the question), without referring to the mental state of the protagonist. Ex. How come the swimmer can see the ball? *Because he swims next to Sam (who is holding the ball).*

**Mental state-verbs not otherwise specified:** These constitute of verbs referring to mental states, but don't fall under categories 'desire', 'fact belief', 'value belief', 'changed fact belief' or 'verbs which refer to a belief'. They are: looking forward to, counting on, being afraid that, being happy with, being anxious about, hoping for, liking, finding sad that, being curious about, wondering about, must, may, having intention to, planning, is going to.

**Situational:** Dwelling on the situation without reference to the mental state of the protagonist. Ex. Why does Sam look embarrassed? *Because his swimsuit is missing.*

**General knowledge reference:** The child refers explicitly to a normality or logicity. Ex. Why does Sam look for his grandfather behind the door? *Because grandfathers he cannot be under the table; grandfathers find it difficult to crawl under tables.*

**External characteristic of subject/object:** The child explains the exterior characteristics of a person or object. Ex. How come Sam can see the bread? *Because he has eyes.*

**Own reference frame with mental state:** In these situations the child describes a mental state, giving an answer in the form of a belief or desire (think, know, like, want, dare etc), or that an emotion is involved in the answer. However, this answer refers to the child himself; how he/she would react in the same situation. Or the child gives an own interpretation of the situation and makes up things which (indirectly) relate to the context of the question, but goes too far.

**Own reference frame without mental state:** This answer is similar to the former one, but without using a mental state.

**Reiteration of question:** When the answer is a repetition of an emotion or action from the question. This doesn't have to be a literal repetition. Ex. Why does Sam look happy? *Because he is happy.*

**Irrelevant/uninterpretable:** This answer is a nonsense answer; it has nothing to do with the question. It is neither an explanation nor an answer to the question. Ex. How come Sam looks for the chickens in the coop? *Because I think that Teletubbies go looking there.*

**Doesn't know:** When a child says he/she does not know the answer.

**Doesn't say:** When a child is silent; he/she gives no answer.

**Missing:** The answer is unreadable or inaudible.

**Not applicable:** When a question was accidentally not asked.

